Single and multi-turn properties of the LHC cleaning system

R. Assmann, SL/AP

BCSG 12/3/02

How to relax severe beta and orbit tolerances?

Origin of these tolerances: **Secondary collimator must not become primary collimator!**

Consequence: **Orbit** change + **beam size** change…

… between primary and secondary collimator…

… must be **smaller than collimation depth**!
(< 1 σ or about 200 μm, top)

Questions: *Can we put secondary collimators at the same location as primary collimators (inherently safe)?*

Maybe go to three stage system to capture first turn debris (more collimators but very robust)?

Set-up for simulations (as usual):

Linear tracking

Ideal optics

Ideal orbit

Top energy, nominal emittance

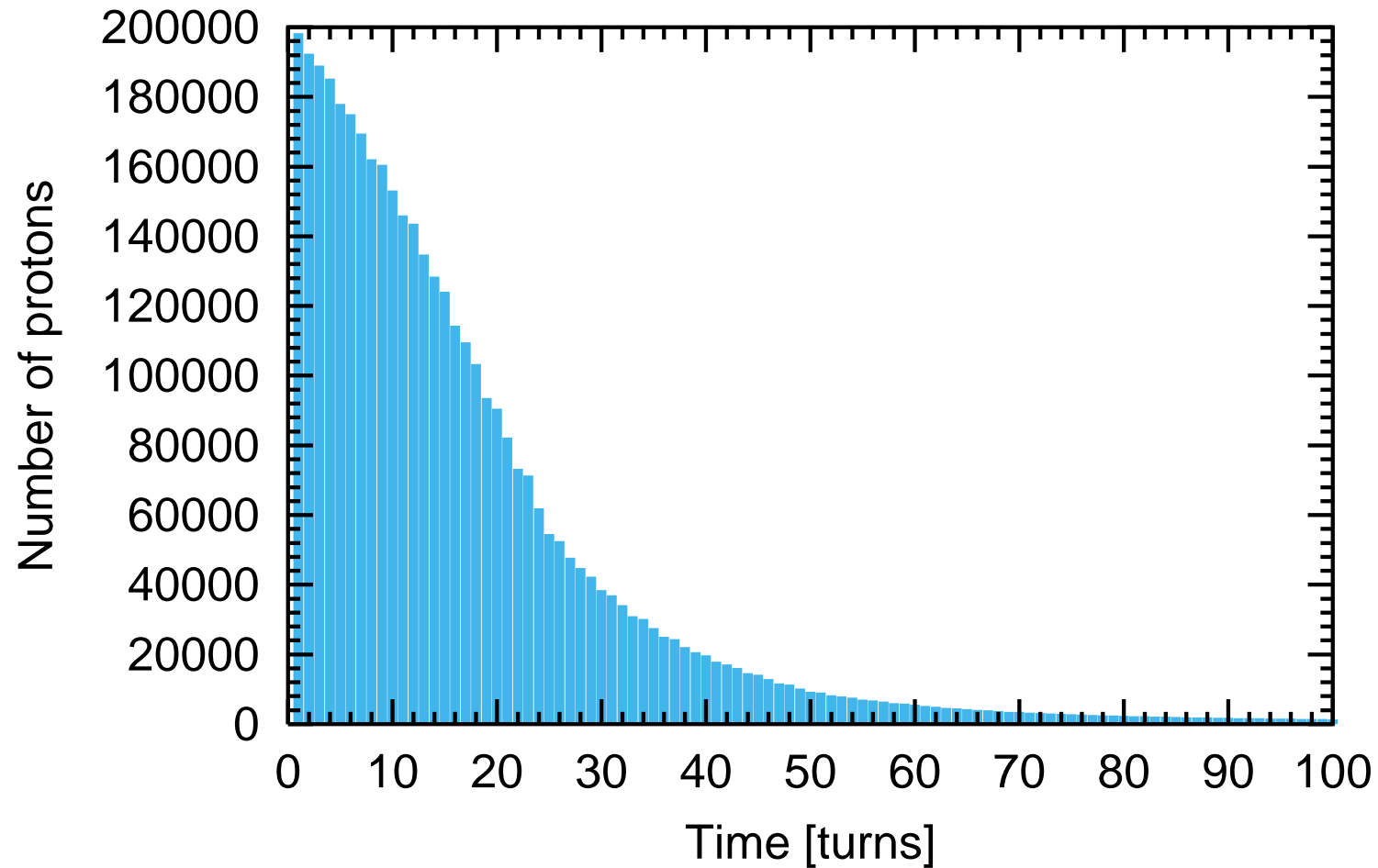Impacting halo with 200000 particles, only y

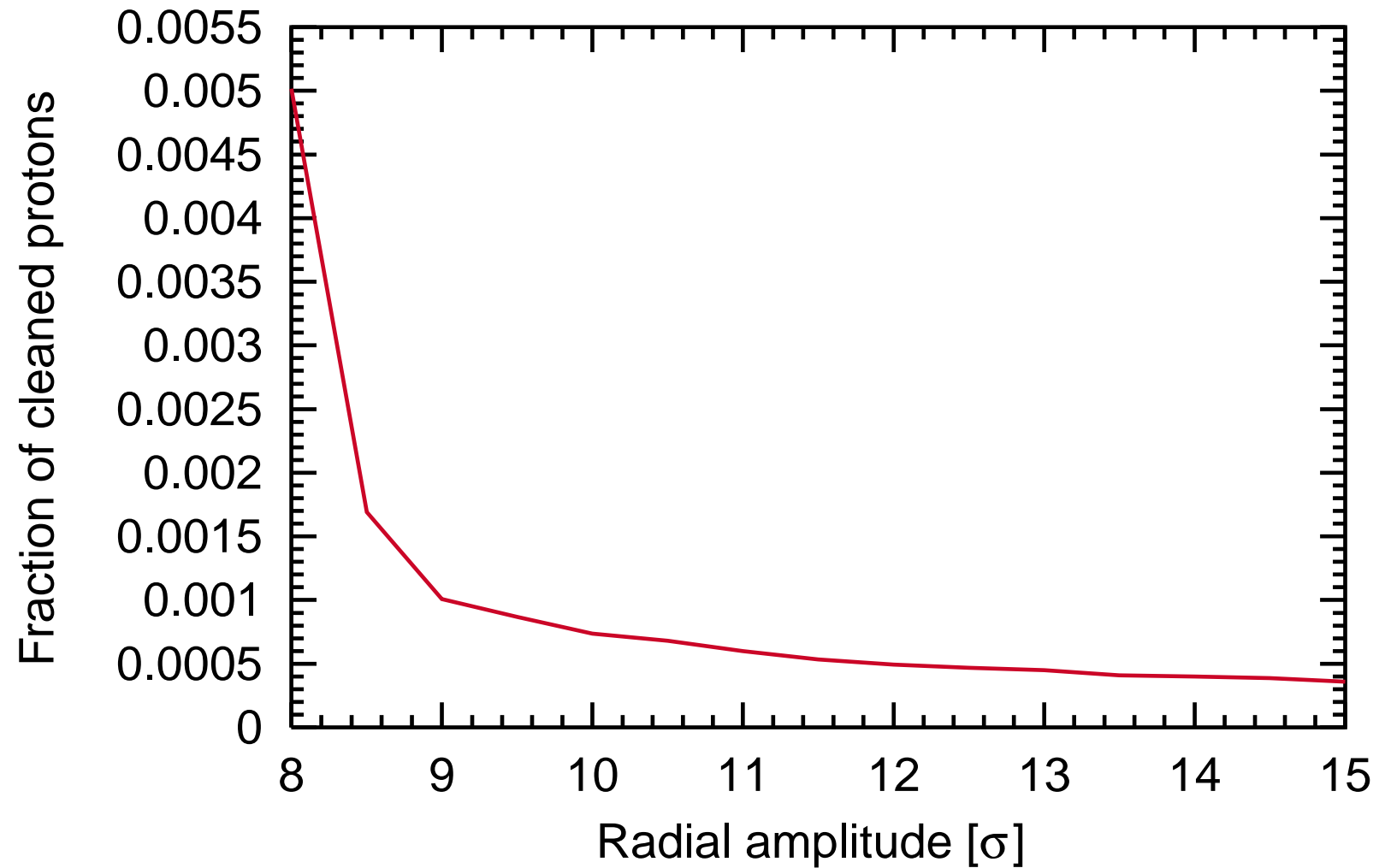Collimation depth is 6/7 σ

100 turns

Present LHC collimation system (AL, Cu)

No errors in collimator orientation, alignment

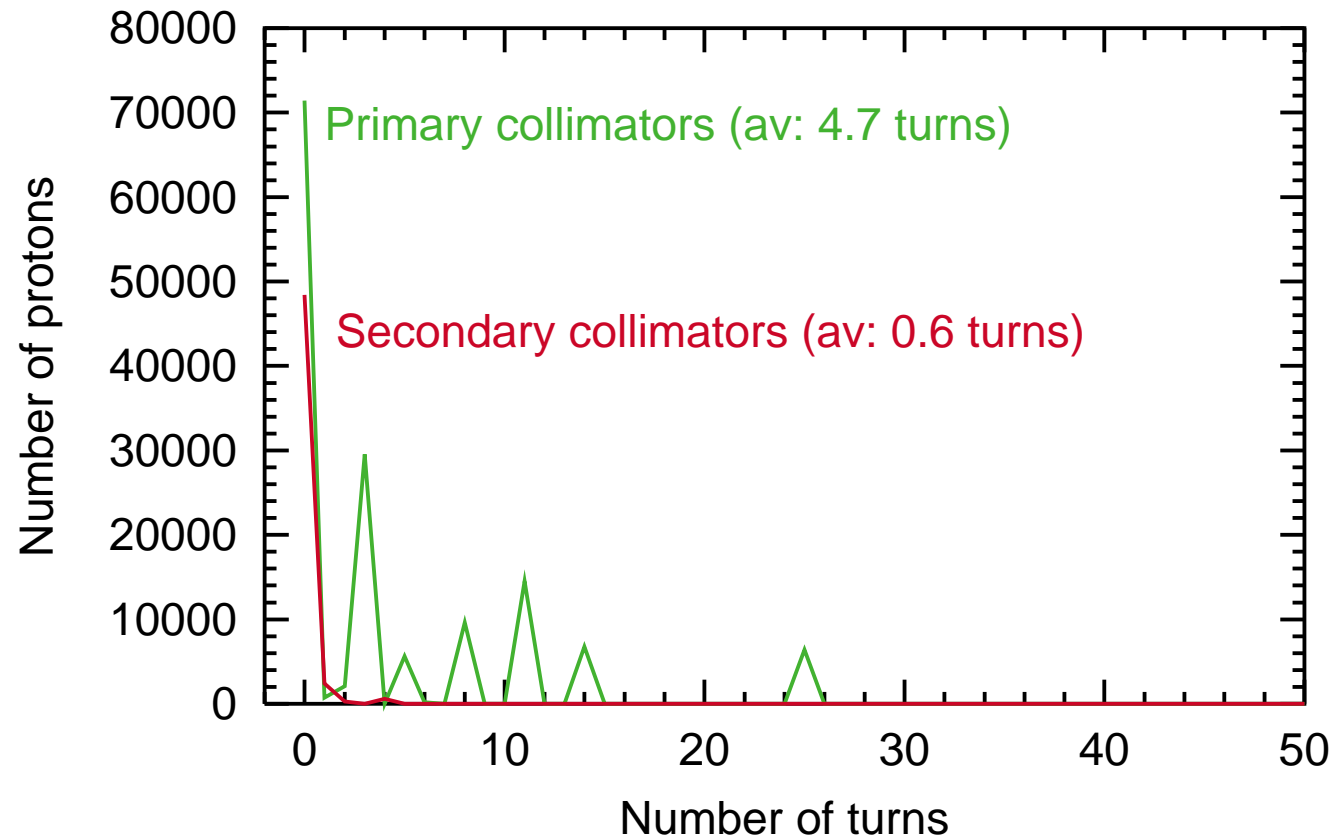# The cleaning is a multi-turn system:
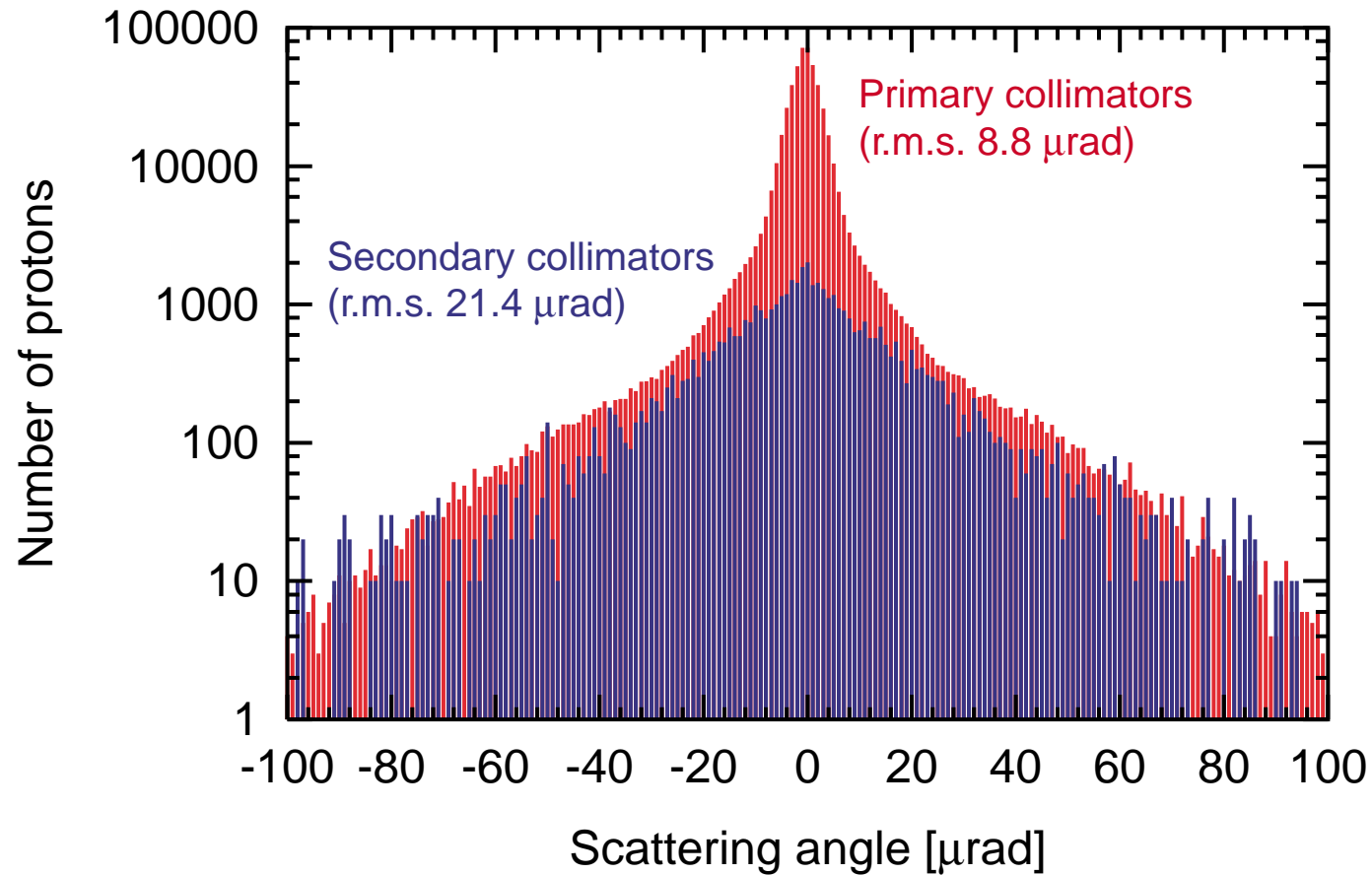
Cleaning efficiency:

Number of turns between…

Previous scattering in collimator   +   Inelastic interaction (absorption)

Primary collimators (av: 4.7 turns)

Secondary collimators (av: 0.6 turns)

Secondary collimators catch mainly protons that were scattered in the same turn! They have almost no multi-turn cleaning purpose!

Scattering angles of escaping protons:

Primary collimators: Small scattering angles return to primaries, large
scattering angles are caught in the secondaries!

Conclusion:

Primary collimators do the multi-turn cleaning.

Secondary collimators catch the single-turn debris (phase advance conditions are important).

We cannot simply remove the secondary collimators and move them to the place of the primary collimators (as expected)!

Can we find a very robust three-stage collimation system with thin primary collimators (hybrid system)?

Work will continue on this…